A Guide to Health

For the Use of Soldiers

Surgeon-Major R. C. Eaton

"Life is not to live, but to be well."—MARTIAL.

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BY

SURGEON-MAJOR R. C. EATON,

MEDICAL STAFF.

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PREFACE.

THE object aimed at in this little work is to instruct the soldier in preserving his health and in promoting his physical development, whereby he may increase not only his own well-being and comfort, but his efficiency in the Service.

It can hardly be said that even the officers of the Army sufficiently realise the inestimable advantages which result from the adoption of sanitary precautions both in barracks and camps; and among the men the injury done by neglecting the simplest rules of health is beyond their comprehension.

Disease cannot exist without a cause; and there is abundant evidence that we ourselves, through ignorance or carelessness of the laws of life and health, are answerable for the vast majority of the ailments which afflict us.

In compiling this little book, the following authors have been consulted:—"Parkes' Practical Hygiene"

(De Chaumont), " Principles of Hygiene" (Willoughby), "The Book of Health" (Morris), " Hygiene and Public Health" (L. C. Parkes), "The Hygiene of Armies in the Field" (Rawlinson), "Madras Manual of Hygiene" (King), " On Disorders of Digestion" (Lauder Brunton), "Energy in Nature" (Carpenter), "Health" (Wilson), "Epidemics of the Middle Ages" (Hecker), "Edinburgh Health Lectures," "An Account of Lazarettos" (Howard), and various Health pamphlets.

A GUIDE TO HEALTH:

FOR THE USE OF SOLDIERS.

SECTION I.

INTRODUCTORY.

THE human body is a most wonderful, complex, and perfect machine, within which its several organs are continually performing the various functions of life. Each organ fulfils its own special duty, but perfect health is only possible when they all work in harmony; because derangement of one organ is almost certain to throw the others out of gear. A vigorous and healthy life is the result of the proper and harmonious performance of all the bodily functions.

The human machine requires a sufficient supply of fuel to enable it to perform its work; and it has been found that a healthy man, under ordinary circumstances, will consume nearly a ton and a half of material in the shape of solid food, air, and water in the course of a year. Nor is this too much when we consider the

enormous amount of incessant work which the functions of his body entail.

We learn from scientific calculations that the *energy* or *power of doing work* which an average man exhibits in the twenty-four hours is equal to 3,400 foot-tons—that is to say, the total force he expends in his work of twenty-four hours would raise 3,400 tons one foot from the ground. Of this amount of force about one-tenth is used in the external movements of the body, the remaining nine-tenths being required for doing the vast amount of *internal* work, such as the movements of the heart and lungs, the digestion of the food, &c., and maintaining the heat of the body at its natural standard —98·5 Fahr.

It may be interesting to observe that the work performed by a man's heart in the twenty-four hours is equal to raising 124 tons one foot high; that the force he expends daily in keeping himself warm is represented by a power sufficient to raise 2,800 tons one foot; and that the work of his chest and lungs is estimated at 21 foot-tons. So that our daily life represents an amount of work which would be almost incredible were it not that the accuracy of these calculations has been proved by the experiments of Professor Haughton and other scientific observers.

A close resemblance is said to exist between the

living machinery and that of the steam-engine. The force which moves the steam-engine is the result of the combustion of fuel by combination with the oxygen of the air drawn into the furnace; the force which maintains the heat of the body and performs the other acts of life is derived from the combustion of food by union with the oxygen of the air taken into the body by the lungs during breathing. Here, however, the resemblance ceases, for there is no machine made by human hands which is capable of executing its own repairs, or of increasing in size and strength—growing.

Contrasting the working power of the steam-engine with that of the human body, Sir William Armstrong* says: "Observe how superior the result is in Nature's engine to what it is in ours. Nature only uses heat of a low grade, such as we find wholly unavailable. We reject our steam as useless at a temperature which would cook the animal substance, while Nature works with a heat so mild as not to hurt the most delicate tissue. And yet, notwithstanding the high-grade temperature, the quantity of work performed by the living engine, relative to the fuel consumed, puts the steam-engine to shame."

The main conditions under which the human machine is enabled to do the greatest possible amount of work,

* Now Lord Armstrong.

both mental and physical, for the longest period, are based upon very definite principles, and can be laid broadly down. Briefly they are the following :—

I.

The most scrupulous cleanliness of person, clothing, and surroundings.

II.

Abundance of pure air to breathe, by night as well as by day. Every occupied room ought to have direct communication with the outside atmosphere, and ought to be so constructed as to secure a constant supply of fresh air without unpleasant draughts.

III.

Sunlight is as necessary as air for healthy growth and development. Human beings, like plants, grow pale and sickly when deprived of it.

IV.

A sufficient quantity of wholesome and well-cooked food is required to furnish material for the growth and repair of the body, and the production of heat and other forms of force.

V.

Regular and moderate exercise, with due alternation of periods of rest, promotes a healthy and vigorous state

of body and mind. The best exercises are those which call into play all the bodily and mental functions and faculties.

VI.

Clothing is necessary to protect the body from cold and variations of temperature. The garments should be so made as to admit of the freest movements of the limbs, and to avoid injurious pressure upon any part or organ.

In order to learn the practical application of these conditions to the preservation of health, the promotion of physical and mental development, the prevention of disease, and prolongation of life, it is requisite that the reader should acquire a general but clear knowledge of the structure, mechanism, and vital functions of the human machinery.

SECTION II.

THE SKELETON—JOINTS—MUSCLES—NERVES.

THE solid framework of the body is made up of about 210 separate bones, the whole of which is familiarly called the *skeleton.* This bony frame forms a combined lever apparatus, a passive apparatus of motion.

The spinal column, or back-bone, may be considered as the foundation of the skeleton, because the different parts of the framework are connected with it as a common centre. Thus, on its upper extremity it supports the skull; laterally, it gives attachment to the ribs, through which it receives the weight of the upper limbs; inferiorly, the column is wedged in between the haunch-bones, which transmit the weight of the body to the lower limbs.

The spine, being the centre of all the movements of the body, must be pliant and flexible, yet firm to preserve the erect attitude, and to give sufficient protection to the spinal marrow, which it encloses. It is composed of 26 bones, called *vertebræ,* piled one on the other, and joined together by elastic pads of gristle; these not only connect the vertebræ together, but act as buffers to

prevent shocks being transmitted through the spine to the brain.

The skull, including the face, is constructed of 22 bones. Of these, 8 go to form a beautifully firm case for the protection of the brain, while 14 enter into the formation of the face. All these bones are more or less firmly united one with the other, except the lower jaw, which is provided with most varied and complex movements for the mastication of the food.

The ribs are 24 in number, arranged 12 on each side. They form, with the vertebræ behind, and the breast-bone and rib-cartilages in front, the cavity of the chest, in which are lodged the heart and lungs.

A flat muscular partition, called the *midrif* or *diaphragm*, divides the cavity of the chest from that of the abdomen, which contains the organs of digestion. The diaphragm is the chief agent by which we inspire, or "take in a breath."

Below the abdomen is a basin-shaped cavity—the pelvis—formed laterally and in front by the two massive haunch-bones, and behind by the termination of the spinal column.

On the outside of each haunch-bone is a deep cup-like socket, which receives the rounded head of the thigh-bone, and forms the hip-joint.

The two pairs of limbs—the arms and legs—are

constructed on the same model, with certain modifications which are necessary for the different purposes they are destined to subserve. The upper limbs are possessed of great freedom of movement in various directions; and thus the arm can be more efficiently used as a protection to the head and body generally, and the hand is enabled to fulfil its important duties of grasping and touch.

The lower limbs being designed to sustain the weight of the body, and convey it from place to place, it is necessary that their bones should be of great strength; and this we find is the case, the bones of the thigh, leg, and foot being remarkably strong and massive.

The bones of the foot are arranged so as to form a very powerful arch, extending from the heel to the base of the toes, and supporting on its summit the entire weight of the body. The hinder pier of the arch is formed by two large bones, while the front pier is made up of several smaller bones—an arrangement which gives firmness and stability to the heel, and spring and elasticity to the front of the foot.

The *Joints* are formed between the bones, and include various degrees, as well as forms, of movement; in some the amount of motion is extremely limited, while in others it is free and complete.

Joints, such as those of the elbow, knee, ankle, and

fingers, are called "hinge-joints," because they work after the manner of a door on its hinges, admitting only of a to-and-fro movement. The joints which admit of the greatest variety and extent of motion are the ball-and-socket joints, as seen in the shoulder and hip. Another form of joint—the pivot joint—is illustrated when we turn the wrist or nod the head.

The opposed surfaces of the bones entering into the formation of a joint are covered with a layer of exceedingly smooth elastic gristle, and this is lined by a delicate membrane which pours out a glairy fluid, popularly called "joint-oil." The use of this fluid is to lubricate the interior of the joint, so as to enable the opposed surfaces to work smoothly upon each other.

The ends of the bones forming the joint are kept in position by strong membranous bands, called *ligaments*, and are more or less supported by the surrounding structures.

The *Muscles* constitute the fleshy covering of the skeleton, and give to the different regions of the body their special contour and outline. They are the agents by which the active movements of the body are performed. These movements are brought about by contraction of the muscles—that is, shortening their length—so that the bones between which they are fixed are pulled upon and drawn for a time nearer together.

The majority of the muscles are attached to the bones through the intervention of *tendons* (or sinews), which occupy but a small space as they pass from the bulky muscle to the parts upon which they are designed to act, as the fingers and toes.

The muscles, together with the bones and sinews, are arranged in various mechanical contrivances, whereby efficiency of muscular action and economy of power are both secured.

There are two distinct kinds of muscles—voluntary and involuntary. The former derive their name from the fact that they are under the control of the will, and can be used when we like, such as those of the arms and legs, and of the body generally. The involuntary muscles act independently of the will, and discharge various important duties in the economy of life; they form the muscular walls of the heart, of the blood-vessels, of the stomach, of the intestines, and of some other parts.

The voluntary muscles of the body are brought under the control of the will through the medium of the *nerves*, which communicate, like a set of telegraph wires, between the brain and the several muscles to which they are distributed.

SECTION III.

CLEANLINESS OF SKIN, HAIR, NAILS, TEETH, CLOTHING, AND SURROUNDINGS.

THE duties of the skin in relation to health are of the greatest importance. It is not only a protective investment which covers the whole surface of the body, but it regulates the bodily heat, and acts as a purifier of the blood.

The outer layer of the skin—called the scarf-skin—is dense and hard, especially where it is exposed to friction, as in the palms of the hands and soles of the feet. Beneath it lies the true skin, which, being richly supplied with blood-vessels and nerves, is highly sensitive. Between the two skins there is a layer of cells containing colouring matter, which causes the various shades of complexion in the different races of man. The shade is deepest when the particles of colouring matter are most abundant, as is the case in the negro.

Imbedded deep down in the skin are numerous little sweat glands; these consist of coiled-up tubes, which, after a spiral course through the substance of the skin, terminate on its surface by openings called *pores*. There

are about 2,500,000 of these pores on the surface of a man's body ; and if the glands were uncoiled and placed one after the other, they would form a tube twenty-eight miles in length.

Through this drainage system there is constantly going on an exudation of watery fluid, or sweat, containing various waste-matters derived from the worn-out tissues of the body. The evaporation of this fluid from the surface serves to maintain the uniform temperature of health, and at the same time it relieves the blood of a large quantity of impurities.

Besides the sweat glands, there are others opening on the surface, called oil glands ; these produce an oily substance, which aids in preserving the softness and elasticity of the skin.

The total quantity of water and solids which thus escapes from the surface of the body varies greatly, according to the heat of the atmosphere, the fluids drunk, and exercise taken ; but a healthy man, under ordinary conditions of life, gives off from his skin daily, in the form of sweat, about two pints of water, about 300 grains of solid matter (organic impurities), and about 400 grains of carbonic acid.

To maintain the skin in activity and health, it must be kept scrupulously clean. When the body is not regularly washed, the solid constituents of the perspira-

tion or sweat accumulate on the surface and block up the pores, thus obstructing the natural and healthy action of the sweat glands.

This arrest of the ordinary work of these glands produces skin diseases; and the blood, not being relieved of its impurities, falls gradually into an unhealthy condition, and is apt to cause fevers and other ailments.

Besides personal ill-health, the owner of a dirty skin becomes a serious nuisance, if not an actual danger, to the health of others. "The great sanitary law," said Sir Lyon Playfair, "is 'wash and be clean'; and anything which stood in the way of observance of that law impaired the health of all communities."

Water alone is not sufficient to maintain the skin in a healthy state; plenty of soap and strong rubbing must also be employed, in order that the deposit of sweat and greasy matters may be dissolved and washed off. A warm bath is more effectual in cleansing the skin than a cold one; but it is not so bracing, and is better adapted to relieve the feeling of great fatigue that follows prolonged exertion. We are told that Napoleon used to have recourse to a warm bath after the fatigue of a battle, and found it more refreshing than even sleep.

All men in health should take a cold bath or cold

sponge every morning, with a warm or tepid bath once a week as a periodical cleanser. Nothing is more invigorating to the nervous system than the "morning cold tub," and its daily use enables the body to resist the effects of sudden changes of temperature.

A useful substitute for the sponge bath consists in wringing a rough towel out of cold or tepid water, and vigorously rubbing the whole surface of the body with it.

The Turkish bath, followed by the cold douche, is admirably adapted for cleansing the skin, and is found beneficial to persons of sedentary habits, and to those whose skins do not naturally act well; but it does not agree with everyone, and should only be used under medical advice.

As regards open-air bathing, the sea is more invigorating than the river or lake. The saltness of the sea water and the pure sea air tend to promote the appetite, to strengthen the muscles, and to impart a healthy tone to the nervous system.

The following simple rules, drawn up by the Royal Humane Society, should be observed by all bathers:—

1. Never bathe within two hours after a meal.

2. Never bathe when exhausted or in ill-health. The practice of plunging into water after exercise is to be thoroughly condemned.

3. Never bathe when the body is cooling after perspiration.

4. A morning bathe may be taken by those who are strong and healthy before breakfast on an empty stomach.

5. The young, or those who are delicate, should bathe two or three hours after a meal, and in the forenoon, if possible.

6. The signs which forbid open-air bathing altogether are chilliness and shivering after entering the water, numbness of hands and feet, and deficient circulation generally.

7. When the body is warm, bathing may be indulged in, provided undressing is quickly accomplished, and the body is not chilled before entering the water.

8. On leaving the water, dry and dress *quickly*. Standing about undressed, after leaving the water, is, under any circumstances, injurious.

9. Rather cut short, than prolong, the bathe. Swimmers possess the power of remaining in the water for a considerable time, in consequence of their active movements. But even in their case injury is often wrought by unduly extending the exercise. The slightest feeling of chilliness should be taken as a sign to leave the water at once.

10. Lastly: we may repeat the wholesome advice that those who experience any disagreeable symptoms after bathing—such as palpitation, giddiness, &c.—should not again enter the water without consulting a doctor.

The *Hair* is an appendage of the skin, and being a natural adornment, generally receives a fair share of attention. From a health point of view, the chief requirement is cleanliness. It should be cut short once a fortnight—a practice which not only facilitates cleanliness, but tends to strengthen the after-growth. When short, the hair may be washed with soap and water daily, but after washing it should be thoroughly dried, and a little oil or pomatum used, to supply the place of the natural oil which has been washed off.

Regarding the use of the hair-brush and comb, Dr. Jamieson, in his "Edinburgh Health Lecture," says: "Brushing should be gentle, and a brush with bristles which are neither too stiff nor too closely set should be chosen. A hard brush breaks and bruises the hair, although it seems to be doing good by scraping off a cloud of dust. One is apt to forget that the scurf re-forms faster than ever when thus roughly scratched away. Use, then, a soft brush, and use it gently. And wash the head once a week or fortnight, if not habitually daily. The teeth of the comb should not have sharp

points, as these tear the skin of the head. A small tooth comb should never be used."

The *Nails,* which protect the sensitive tips of the fingers and toes, require the bestowal of some care and attention on their culture. The under surface of the free edge of the nail should never be scraped or picked with a knife, but washed with soap and water and a soft brush. The finger nails should be cut round, and the toe nails straight across. To prevent a painful affection known by the term "agnail," the skin at the roots of the nails should be gently pushed back after each time the hands are washed.

In the German army, where every little detail is attended to, the barber of each battalion is held responsible that the men's toe nails are properly cut and that their feet are kept clean and healthy.

The *Teeth* are most important agents in the work of digestion, and their preservation is therefore an important element in the preservation of health. The first step in the digestive process is the grinding of the food by the teeth, which is called mastication, and if this, either from habit or unsound teeth, be imperfectly performed, indigestion, with all its accompanying evils, is sure to follow. Slow and careful mastication is essential in order that the food may be reduced to that state in which it can be most readily and perfectly acted upon

by the different digestive fluids with which it afterwards comes in contact.

When the teeth are neglected, particles of animal and vegetable food lodge between them, and undergo a process of fermentation which develops acids that injure the enamel and eventually destroy the teeth. Against this form of decay scrupulous cleanliness is evidently the best preservative. The mouth should be rinsed out after each meal, and the teeth should be cleaned by brushing every part of them night and morning with soap and water or a good tooth-powder, such as camphorated chalk.

Cleanliness of Clothing.—The under-clothing absorbs and retains the exudations from the skin, which tend to decompose and become offensive ; for this reason such articles as shirt, vest, drawers, and socks should be frequently changed and washed. The under-clothing worn during the day should be removed at bed-time, to be replaced by cotton night-shirts. This allows the day garment to get dry and aired during the hours of sleep. Dr. Parkes says : " In time of war, shirts may be partially cleaned in this way : The soldier should wear one and carry one ; every night he should change ; hang up the one he takes off to dry, and in the morning beat it out and shake it thoroughly. In this way much dirt is got rid of. He should then carry this shirt in his pack during the day, and substitute it for the other at night."

The outer garments also get more or less impregnated with perspiration, and require to be aired and dried from time to time, so as to get rid of all moisture.

The bed-clothes which have been in use during the night should be exposed to the air for a few hours before being re-arranged. This salutary practice not only frees them from the exhalations which they absorb from the skin and lungs, but greatly adds to the comfort of the bed at night and conduces to sound sleep.

Cleanliness of Surroundings.—Scrupulous attention to the cleansing of habitations, including the removal of slops, refuse, excreta, &c., is a matter of the utmost importance to health. The great principle is that all should be rapidly and completely removed from the house and its vicinity, "so that neither air, water, nor soil shall be made impure." The water method of removal is the cleanest and most convenient, especially where there is a good supply of water, sufficient outfall, and means of disposing of the sewage. The dry earth method is that which is usually adopted in India, and has many advantages.

Decaying animal matters being the natural food of plants, their ultimate disposal should consist in applying them to the fertilisation of land, thus converting them from dangerous impurities into wholesome food.

The diseases which have been shown to arise from

imperfect systems of sewage removal are enteric fever, dysentery, diarrhœa, cholera, yellow fever, diphtheria, sore throat, and an aggravation of other diseases.

Dust-bins ought to be especially attended to, otherwise they become sources of danger. The disposal of all kinds of refuse by burning with special apparatus is being tried in several large towns, and the plan seems likely to be a complete success.

It may be here stated that *disinfectants* are useful as adjuncts to cleanliness, but they can never be substituted for it.

The best means of purifying a foul atmosphere is by the freest possible ventilation.

SECTION IV.

AIR, VENTILATION, SUNLIGHT.

AIR is the first necessity of life. We can exist without water for days, and without food for weeks, but the air around us we must breathe, or die.

We breathe for the purpose of freeing the blood from the waste products of the body, the retention of which in the system would be prejudicial to health, if not destructive of life. During the act of breathing the blood charged with the decaying matters from the worn-out tissues is exposed to the purifying action of the air in the lungs ; by this contact with the air, the blood gives off carbonic acid, organic matters, and watery vapours, which are expelled by the windpipe, and absorbs oxygen from the freshly-inspired air.

But if the atmosphere is impure, as in rooms where there is not sufficient ventilation, the necessary purification of the blood cannot take place.

When a number of people are collected together in a badly-ventilated room, the air of that room quickly becomes impure by the accumulation of carbonic acid and organic vapours given off from the lungs and skins

of the occupants. Breathing such an atmosphere for even a few hours produces headache, nausea, and other feverish symptoms; and the continued re-breathing of the same air renders it in the highest degree poisonous.

Of this we have two sad instances on record. On the night of the 18th of June, 1756, one hundred and forty-six prisoners, including one woman, were thrust into a dungeon, the Black Hole of Calcutta—a place 18 feet by 14 feet, and having but two small windows, and so densely packed, that the door had to be pressed on the last to enter.

The atmosphere of this confined place speedily became poisoned with carbonic acid and organic impurities; and the result was, that only twenty-three survived the horrors of that night. The few survivors, from what they suffered, called the place "hell in miniature."

Again, on the 1st of December, 1848, the steamer *Londonderry* was crossing the Irish Channel, when, a storm coming on, the one hundred and fifty passengers were confined below the hatches, which were battened down. Of these persons, seventy were poisoned by the impure air.

Living habitually in an atmosphere more moderately tainted with the products of respiration tends to produce consumption and other lung diseases. The late Sir

James Clark has said: "If an infant, born in perfect health and of the healthiest parents, be kept in close rooms, in which ventilation and cleanliness are neglected, a few months will often suffice to produce consumptive disease." Dr. Parkes, too, states: "The average mortality in this country increases tolerably regularly with density of population. Density of population usually implies poverty, and insufficient food, and unhealthy work, but its main concomitant condition is impurity of air from overcrowding, deficiency of cleanliness, and imperfect removal of excreta; and when this condition is removed a very dense and poor population may be perfectly healthy."

Further, overcrowded and ill-ventilated places tend to increase the virulence and spread of infectious diseases.

From these simple facts we learn the importance of having pure air to breathe, and, therefore, of the free ventilation of our dwellings.

Doors, windows, and chimneys should be utilised as aids in the work of ventilation. In summer, the passage of a natural stream of fresh air through open doors and windows is the most efficient means of ventilating a room; in winter, the chimney in a room in which a fire is burning forms an excellent ventilator.

The essential points are to provide outlets for the

escape of foul air, and inlets for the admission of fresh air.

The foul air, heated by lights and by being breathed ascends; therefore the outlets should be near the ceiling. The inlets should be 9 or 10 feet from the floor, unless when the air is warmed before admission; then the inlets may be at the bottom of the room.

Every window in the house should be kept open an inch or two at the top, or, as suggested by Dr. Hinckes Bird—"Raise the lower sash a few inches, and fill up the vacant space with a block of wood, so that the lower sash will rest upon it. The result will be that a current of air flows in between the bottom of the upper sash and the top of the lower sash without draught or annoyance."

Bedrooms require to be supplied with fresh air not only during the day, but whilst we are asleep. At night the windows should be kept slightly open at the top in winter, and wide open in summer. In addition, every room should be flushed through with air, when not occupied, by opening freely the doors and windows. By this means the organic matters and other impurities floating in the atmosphere of the apartment are carried off, and their poisonous qualities completely destroyed.

The sense of smell gives a fair idea of the amount of impurities in the air of a dwelling-room, but it is

necessary that the observer should enter the room after being some time in the open air, because breathing foul air rapidly destroys the perception of its foulness.

It is estimated that the quantity of pure air that should pass through an inhabited room in order to maintain the atmosphere in a condition fit for breathing is 3,000 cubic feet per head per hour.

In this climate, it has been found by experiment that the air of a room cannot be changed more frequently than three times per hour without causing an unpleasant draught; therefore, each person ought to have a breathing space of 1,000 cubic feet. That is, a room 10 feet square by 10 feet high represents the amount of superficial area and cubic space which should be allotted to each individual, and the air of this room should be changed three times per hour.

Howard, the great philanthropist and reformer of prisons, so long ago as a century, said: "It may be asked of what size I would wish prisoners' solitary *night rooms* to be? I answer, ten feet long, ten feet high, and eight feet wide." At the present day the cubic space allotted to each man in barracks is only 600 cubic feet.

In estimating the quantity of air to be supplied to inhabited rooms, fires and lights must be taken into account. A pound of coal requires 240 cubic feet of

air for complete combustion, the resulting gases and other products escaping by the chimney. A common gas-burner consumes as much air as three or four men, and an ordinary oil-lamp or candle as much as two men.

The sick require a much larger supply of fresh air than healthy persons; in fact, in many diseases almost complete exposure to the air not only favours the recovery of the patients, but prevents the spread of disease.

SUNLIGHT.

Dwelling-rooms ought to be so arranged that they may receive plenty of sunlight, which, as a means of promoting a vigorous state of health, is as necessary as fresh air. This is now so fully recognised by medical men, that sun-baths are provided for the patients in many of the hospitals, both in this country and in America.

Recent experiments, conducted by Professor Tyndall, have shown that direct sunshine arrests decomposition, and has a valuable chemical power of destroying disease germs.

The Italian proverb, " Where the sun does not come the doctor does," is perfectly true.

SECTION V.

FOOD AND COOKERY.

Every act of life, however simple, involves destruction of tissue, wear and tear, which must be replaced by new material. In order to provide this new material to supply the place of the destroyed structures, we take food.

The purposes of food are two-fold. It supplies building material for the growth and repair of the bodily frame, and furnishes fuel for the production of heat and energy for working the human machine.

For the due performance of these purposes, four great classes of nourishment are necessary :—

1st. Nitrogenous, such as albumen, myosin, gelatin, casein, and gluten. Of these, albumen, myosin, and gelatin are derived from butcher's meat, poultry, eggs, and fish. Casein is found in milk, and gluten in most vegetable foods, notably in wheat. The special functions of the elements of this class are to build up and repair the constant waste of the body.

2nd. Fats, such as butter, lard, suet, dripping, and

vegetable oils. These substances are the principal sources of bodily heat and motive power. Fat also enters largely into the composition of all nervous structures, and it aids in the digestion of other substances of a diet.

3rd. Starchy and saccharine: the former includes arrowroot, sago, tapioca, corn-flour, gum, and nearly all the farinaceous foods; the latter consists of the different kinds of sugar—cane, grape, beet, &c. All these are important articles of a diet, and greatly assist in the production of heat and force for work.

4th. Salts and water—the former being common salt, lime, soda, potash, magnesia, phosphates, iron, &c. Common salt is required to promote digestion, while the others are essential constituents of the different structures and fluids of the body. Water is even more essential to life and health than food of any other class, for without it all the others would be useless. It enters into every tissue, forming more than two-thirds of the entire weight of the body; and it is necessary for the performance of every act of life.

A considerable amount of the water which the body requires is supplied in the so-called "solid food."

The following Table, giving the nutritive value of different kinds of solid food, shows that they all contain a large percentage of water.

TABLE FOR CALCULATING DIETS.

(From "Parkes' Hygiene.")

Articles.	In 100 Parts.				
	Water.	Albuminates.	Fats.	Carbohydrates.	Salts.
Meat of best quality, with little fat, like beefsteaks, . .	74·4	20·5	3·5	...	
Uncooked meat of the kind supplied to soldiers—beef and mutton. Bone constitutes $\frac{1}{5}$th of the soldier's allowance,[1]	75	15	8·4	...	1.9
Uncooked meat of fattened cattle. Calculated from Lawes' and Gilbert's experiments. These numbers are to be used if the meat is very fat, ...	63	14	19	...	3·7
Cooked meat,[2] roast, no dripping being lost. Boiled assumed to be the same, . .	54	27·6	15·45	...	2·95
Corned beef (Chicago),[3] . .	40	40	15	...	5
Salt beef (Girardin), . .	49·1	29·6	0·2	...	21·1
,, pork (Girardin), . .	44·1	26·1	7·0	...	22·8
Fat pork (Letheby), . .	39·0	9·8	48·9	...	2·3
Dried bacon (Letheby), . .	15·0	8·8	73·3	...	2·9
Smoked ham (J. König), . .	27·8	24·0	36·5	...	10·1
Horse flesh do. . .	74·3	21·7	2·6	...	1·0
White fish (Letheby), . .	78·0	18·1	2·9	...	1·2
Poultry (Letheby), . . .	74·0	21·0	3·8	...	1·0
Bread, white wheaten, of average quality, ...	40	8	1·5	49·2	1·3
Wheat flour, average quality, .	15	11	2	70·3	1.7

[1] The gelatine of the meat is reckoned with the albuminates; it is not certain what deduction should be made on account of its lower nutritive value, which is about $\frac{1}{5}$th that o albumen (Bischof).

[2] These numbers are taken from John Ranke's analysis.

[3] This is excellent meat, palatable and nutritious; half a pound would form an ample ration for the field, with the due proportion of biscuit, &c. As it is merely *corned* and not *salted* like ordinary salt meat, it is probable that its constituents may be allowed nearly their full nutritive value.

Articles.	In 100 Parts.				
	Water.	Albuminates.	Fats.	Carbohydrates.	Salts.
Biscuit, ...	8	15·6	1·3	73·4	1·7
Rice, ...	10	5	·8	83·2	0·5
Oatmeal (Letheby), . . .	15	12·6	5·6	63·0	3
Maize (Poggiale) (cellulose excluded), ...	13·5	10	6·7	64·5	1·4
Macaroni (König), . . .	13·1	9·0	0·3	76·8	0·8
Millet (König) (cellulose excluded),	12·3	11·3	3·6	67·3	2·3
Arrowroot, ...	15·4	0·8	...	83·3	·27
Peas (dry), ...	15	22	2	53	2·4
Potatoes, ...	74	2·0	·16	21·0	1
Carrots (cellulose excluded), .	85	1·6	·25	8·4	1·0
Cabbage, ...	91	1·8	·5	5·8	·7
Butter, ...	6	·3	91	...	variable taken as 2·7
Egg (10 per cent. must be deducted for shell from the weight of the egg), . .	73·5	13·5	11·6	...	1
Cheese, ...	36·8	33·5	24·3	...	5·4
Milk (sp. gr. 1029 and over), .	86·8	4	3·7	4·8	·7
Cream (Letheby), . . .	66	2·7	26·7	2·8	1·8
Skimmed milk (Letheby), .	88	4·0	1·8	5·4	0·8
Sugar, ...	3	...	...	96·5	·5
Pemmican (de Chaumont),[1] .	7·2	35·4	55·2	...	1·8

The principles composing the four classes of nourishment must be present in certain proportions in every diet which is to maintain life in its most perfect state for a lengthened period. Excess or deficiency of any one class exercises a very unfavourable influence on health.

Although man almost universally derives his food from both the animal and vegetable kingdoms, it is quite

[1] The sweet pemmican used in the Arctic Expedition of 1875—6 was similar to the above (the ordinary pemmican used in the same expedition), with the addition of about 5 per cent. of cane sugar. In other cases, particularly in the American pemmican, raisins and currants are added. (See *Report of Committee on Scurvy* for analyses by Professor Franklin and Dr. de Chaumont.) A little pepper is added, not reckoned quantitatively in the above analysis, but probably included in the "loss," *i.e.*, the difference between the sum of the above constituents and 100.

possible for him to obtain the principles necessary for his growth and development from the vegetable world alone; but, apart from his general inclination, the construction of his digestive apparatus shows that he is designed to live on a mixture of animal and vegetable food. Moreover, a mixed diet is that which is best adapted to supply the requisite materials in proper proportion for the wants of the human body.

Milk, which is provided by Nature as the only nourishment for the young of man and beast for many months after birth, contains all the elements needed for the support of life and growth, and may be regarded as the type of what a food should be. It is not fitted, however, to be the sole food of the adult; but when taken with other articles of food—such as oatmeal porridge, bread, or rice—it is invaluable. Cow's milk is that which is most generally used for human food, but the milk of the buffalo, goat, sheep, ass, and mare, are much used in some countries, especially in India and Tartary.

Milk has the evil reputation of occasionally conveying the poisons of fevers, but this is probably always due either to adulteration with dirty water, or to "washing the cans" with that noxious element, or to the milk being exposed to an atmosphere loaded with disease germs. As a protection against the spread of fevers through the medium of milk, it should be boiled,

Exposure to the temperature of boiling water for five or ten minutes removes the injurious qualities of the milk.

The following are the physical characters of good milk, as given by Dr. Parkes:—"Placed in a narrow glass, the milk should be quite opaque, of full white colour, without deposit, without peculiar smell or taste. When boiled, it should not change in appearance."

Preserved milks are now very extensively consumed, and are most valuable when fresh milk cannot be procured.

Butter, which is the fatty portion of the milk, is the most largely used of all the animal fats. It is obtained by the process of churning, and preserved by the addition of salt, in proportion varying from two to eight per cent. Butter is wholesome and easily digested, except when it is becoming rancid. It is then liable to cause indigestion.

Margarine is manufactured from beef or mutton suet by a refining process. When made from the fresh fat of healthy animals, it forms a cheap and wholesome substitute for butter.

Cheese consists principally of the casein of milk, separated from it by the action of an acid—rennet. It contains a large amount of nutritive material in small bulk, and is a valuable article of food. The richness of the milk determines the quality of the cheese. Double

Glo'ster and Stilton are made from new milk to which cream has been added; single Glo'ster, Dutch, &c., from new milk alone; and the poorest kinds of American cheeses from *skim-milk*, or milk from which the cream has been removed.

Eggs, like milk, comprise all the materials requisite for the growth and development of the body. Newly laid eggs are the most easily digested.

A good egg is slightly transparent, and sinks in a ten per cent. solution of common salt. A doubtful egg will float in the above solution, and a bad one even in fresh water.

Our supplies of *Meat* are derived entirely from the vegetable feeders, and chiefly from the ox, sheep, and pig. There is little difference in the relative nutritive values of the flesh of these three animals; they differ only in the proportion of fat and by different degrees of digestibility. Venison and the flesh of other wild animals—game—is no less nutritious than beef or mutton, and in general it is more easily digested. Horse-flesh is extensively used on the Continent and in parts of South America, and has the reputation of being very sustaining.

The advantages of meat as an article of diet are: its composition is identical with that of the body which it is intended to nourish, it is easily cooked, and easily

digested. Its great disadvantage is the absence of carbo-hydrates—starches and sugars; these are, therefore, supplied in a mixed diet by the addition of potatoes, bread, or rice.

Animals intended for human food should be in sound health, in good condition, and neither too young nor too old. Meat should be inspected twelve or fourteen hours after being slaughtered. The following outward characteristics of good meat are given by Dr. Letheby, in his "Lectures on Food":—

"(1) It is neither of a pale pink colour nor of a deep purple tint, for the former is a sign of disease, and the latter indicates that the animal has not been slaughtered, but has died with the blood in it, or has suffered from acute fever.

"(2) It has a marbled appearance, from the ramifications of little veins of fat among the muscles.

"(3) It should be firm and elastic to the touch, and should scarcely moisten the fingers; bad meat being wet, and sodden, and flabby, with the fat looking like jelly or wet parchment.

"(4) It should have little or no odour, and the odour should not be disagreeable, for diseased meat has a sickly, cadaverous smell, and sometimes a smell of physic. This is very discoverable when the meat is chopped up and drenched with warm water.

"(5) It should not shrink or waste much in cooking.

"(6) It should not run to water, or become very wet, on standing for a day or so; but should, on the contrary, be dry upon the surface.

"(7) When dried at a temperature of 212°, or thereabouts, it should not lose more than seventy to seventy-four per cent. of its weight, whereas bad meat will often lose as much as 80 per cent."

Poultry—fowls, turkeys, etc.—and rabbits are equally nutritious with butcher's meat, but they are deficient both in fats and salts. Hence it is usual to combine bacon, ham, or tongue with them to supply the deficiency. The flesh of ducks and geese is very rich in fats, and consequently liable to disagree with delicate stomachs.

Fish, as a general rule, is one of the most wholesome, nutritious, and easily digested of foods. It is valuable not only as an addition to other foods, but as a substitute for meat. The composition of white fish approaches most nearly to lean beef, as shown in the following tables of analyses by Dr. Pavy:—

	Lean Beef.	Fat Beef.	White Fish.
Nitrogenous or flesh-forming matter	19·3	14·8	18·1
Fat	3·6	29·8	2·9
Minerals	5·1	4·4	1·0
Water	72·0	51·0	78·0
	100·0	100·0	100·0

White fish, such as sole, turbot, whiting, plaice, &c., are more easily digested than the rich and oily fishes—salmon, eels, mackerel, herrings, &c. These latter contain from five to fourteen per cent. of fat, and are superior in nutritive power to the white varieties.

Shell-fish contain much valuable nutriment, but they are often found to disagree, and should therefore be used with caution. Oysters in the raw state are the most wholesome and digestible of the ordinary kinds of shell-fish.

The *Crustaceans*, as the lobster, crab, cray-fish, shrimp, and prawn, are highly nutritious, but rather indigestible.

It is most essential that every description of fish intended for human food should be perfectly fresh and "in season."

VEGETABLE FOOD.

There are two classes of vegetable foods—cereals and legumes. Of the cereals, wheat, oats, barley, rye, Indian corn, and rice are the most important. From wheat is prepared the flour of which *bread*, the principal food of mankind, is made. When the wheat grain is ground and sifted, it is separated into two substances—the outer covering, called *bran*, and the inner portion, called *flour*. The bran, though not devoid of nutriment, is to a great extent indigestible, and is used chiefly as food for cattle.

The flour is reduced to varying degrees of fineness, known as superfine, seconds or middlings, pollards or thirds, or bran flour. The fine and white kinds of flour are more palatable and more nutritious than the coarse varieties.

Good flour should be quite white; any decided yellow tinge shows commencing changes and unfitness for use. It should be free from grittiness, sour taste, or mouldy smell.

In making bread, the usual proportions in England are—flour, 20 lbs.; tepid water, 8 to 12 lbs. ($6\frac{1}{2}$ to $9\frac{1}{2}$ pints); yeast, 4 ounces; to which a little mashed potato is added, and $1\frac{1}{2}$ to 2 ounces of salt. One sack (280 lbs.) will make from 90 to 105 loaves; or 100 lbs. of flour will make 129 to 150 lbs. of bread.

In order to obtain good bread, the ingredients must be sound and genuine; they must be skilfully intermixed, the dough thoroughly kneaded, and the process of baking conducted at an uniform temperature of 212° Fahr. The crust of the baked loaf should amount to 30 per cent. of the weight; it should be crisp and well-browned, but not charred. The small cellular cavities in the crumb should be regular and present in every part; the walls of these cavities should not be tough. The colour should be white or brownish, in proportion to the admixture of bran. There should be no sour

taste even] if the bread is held in the mouth for a considerable time.

Heavy and sodden bread is very indigestible, and indicates bad flour, bad yeast, or faulty preparation.

Bread is more digestible when toasted, but the toast should be eaten soon after it is made, otherwise it becomes tough and leathery.

Being deficient in fat, bread requires the addition of butter, fat bacon, or margarine to make it a complete food.

Plain biscuits are simply flour and water mixed, and baked at a high temperature. From being well dried and baked, they are, bulk for bulk, more nutritious than bread, in the proportion of 3 to 4. They are very portable, and possess the great advantage of keeping; but as a staple article of food they are incapable of replacing bread, except temporarily.

Sweet Biscuits are made by the addition of milk, butter, eggs, sugar, &c.

The Indian Chupatty, which forms the principal food of large populations in the North-west, consists merely of wheat flour, water, and salt. It requires to be slowly baked, at a temperature not exceeding that of boiling water. With the addition of butter or *ghee*, it is palatable and nutritious.

Macaroni and *Vermicelli* are made from wheat flour

rich in gluten. They contain a large amount of nutriment in small bulk, and are capable of being cooked in a variety of ways.

Oatmeal is highly nutritious, and has the advantage of being economical. Dr. Parkes kept a strong soldier doing hard work in perfect health on 1¾ lbs. of oatmeal and 2 pints of milk daily, at a cost of fivepence for the meal and fourpence for the milk. The man himself was sorry to return to his soldier's ration of bread and meat.

"Oatmeal is especially the food of the people of Scotland, and was formerly that of the northern parts of England—counties which have always produced as healthy and as vigorous a race of men as any other in Europe." (Cullen.) It cannot be made into bread, like wheat flour, but is used in the form of porridge or cakes. Made into a drink with water and sugar, oatmeal is found to possess great sustaining powers in hard work. The proportions are ¼ lb. of oatmeal to 3 quarts of water; it should be well boiled, and then 1½ oz. of brown sugar added. Before drinking shake up the oatmeal well through the liquid. In summer, drink it cold; in winter, hot. (Parkes.)

Barley is now rarely used in England as an article of food, but is largely employed for brewing and distilling purposes. It is rich in phosphoric acid and iron, and very nutritious. The grain, deprived of its

husk and rounded, is called "Pearl Barley," and is much used as an addition to soups, and for making drinks for invalids.

Rye makes a sour, heavy bread, well known in Germany as "Schwartzbrod," or black bread. It is apt to disagree with those unaccustomed to its use.

Indian Corn, or *Maize*, ranks high in nutritive value, and contains six or seven per cent. of fat. It is extensively used as an article of food both in this country and America. The meal is generally eaten in the form of porridge, and requires very careful cooking to render it digestible. It should be steeped in water for two or three hours, and then boiled for two or three hours at a moderate heat. The young green ears (cobs) make a delicious vegetable when boiled in milk or water. Maize flour, deprived of its harsh flavour by a chemical process, forms the articles sold under the names of "Corn-flour," "Oswego," "Maizena," &c., so much used in the preparation of puddings. "Polenta," which is a favourite dish with the Italian peasantry, is a porridge made with Indian meal and cheese or chestnuts. The "Jonny Cakes" of America are composed chiefly of Indian meal.

Rice is the staple food of the natives of India and China, but in Europe is used more as a luxury than a food. Marsden, in his "History of Sumatra," says:

"Rice is the grand material of food on which a hundred millions of the inhabitants of the earth subsist, and although chiefly confined by nature to the regions included between and bordering on the tropics, its cultivation is probably more extensive than that of wheat, which the Europeans are wont to consider as the universal staff of life." In composition, it is poor in nitrogenous substances, but rich in starch, and has the advantage of being easily digested. Rice-flour may be made into cakes, but does not admit of being made into bread, unless when mixed with wheat-flour and other things. Rice should be thoroughly cooked by boiling or steaming, the latter being the preferable method.

There are several other varieties of grain used in India and Africa, but in this country they are almost unknown.

The Legumes include peas, beans, lentils, &c. Of these, peas are the most extensively consumed, and may be regarded as a type of the class; they contain a large amount of nutritious matter, and when young and green are easily digested. The meal of the dried pea, if thoroughly boiled, forms a nutritive addition to soup. A valuable concentrated food—Erbswurst—is made by mixing together, cooking, and baking pea-flour, meat, and fat, with a little salt and pepper. It can readily be made into a palatable and nutritious soup. The

exact process of manufacturing Erbswurst is not published.

Potatoes constitute a wholesome and popular article of food ; they contain a large proportion of starch and some valuable anti-scorbutic salts. Their absolute nutritive value is not great, but when eaten with fat bacon or butter, they are capable of sustaining life and vigour. Potatoes should be boiled in their skins ; otherwise their flavour is injured, and a large proportion of the salts passes into the water. Steaming is the most economical method of cooking them.

Cabbages, carrots, parsnips, turnips, and other succulent vegetables, contain very little nutriment, but are valuable chiefly on account of their anti-scorbutic properties ; they are also useful for imparting flavour and variety to other articles of greater nutritive value. Stale vegetables are to be avoided, as they undergo changes similar to those which take place in animal food, and are liable to produce derangement of the digestive organs. As regards compressed vegetables, it is extremely doubtful whether they possess any anti-scorbutic properties whatever. When fresh vegetables are not procurable, lime-juice should be substituted.

Condiments, such as mustard, pepper, vinegar sauces, &c., whilst having no nutritive value of their

own, add flavour to insipid substances, and stimulate appetite and digestion. They should, however, be used in moderation, for when taken in excess they act injuriously on the digestive organs.

AMOUNT OF FOOD REQUIRED.

The *quantity* and *kind of food* required to sustain life in a healthy condition must necessarily vary according to age, exercise, and climate.

In early life, growth and development must be provided for in addition to the other requirements of the body. A growing lad, as a recruit, whose frame is being gradually developed in size and stature, ought to have a daily allowance of from 60 to 70 ounces of solid food, of which about one-fourth should be meat.

At maturity there is less demand for the materials of growth, and, therefore, the relative proportion of animal food should be considerably reduced.

For an average man, doing a moderate amount of work in a temperate climate, the following may be accepted as a fair example of a simple form of mixed diet:—Meat (uncooked), 1lb.; Bread, 1½lbs.; Butter, 1½ ounces; Potatoes, 12 ounces; Milk, 9 ounces; Sugar, 1 ounce; Salt, ½ ounce. In addition to this, from 40 to 80 ounces of Water are required in some form or other. In a state of absolute rest a much smaller supply of

food will suffice. On the other hand, very hard labour demands an increase of food in proportion to the work done.

The careful experiments of two German chemists have shown that the internal and external work of the body is done chiefly at the expense of the fats, starches, gums, &c., and that during great physical exertion not so much extra meat as vegetable food is required.

Climate influences the demand for food, and Nature implants in man a desire for that kind of food which is most in harmony with the wants of his system. Fats and oils are the most powerful heat-producers, and are, therefore, largely consumed by the inhabitants of cold climates. Dr. Kane, in his "Arctic Explorations," says:—"Our journeys have taught us the wisdom of the Eskimo appetite, and there are few among us who do not relish a slice of raw blubber or a chunk of frozen walrus beef. The liver of a walrus (aracktanak), eaten with little slices of his fat, of a verity is a delicious morsel."

In the tropics meat is sparingly used, vegetable food—such as rice in India—forming the chief article of native diet. The splendid races of Northern India live almost entirely on whole-meal cakes, with a little butter or ghee, and can walk fifty or sixty miles a day on this diet.

But in no circumstances should natural appetite be disregarded, for, as Dr. Lauder Brunton remarks :—" In a healthy man, the best guide, both as to quantity and quality, is appetite. Food that is eaten with a relish is, as a rule, wholesome; and sometimes it is rather astonishing to find how people's instincts guide them to what is suitable for them, in utter defiance of all *à priori* notions."

Or, as Dr. Arthur Flint puts it :—" The diet should be regulated by the appetite, the palate, and by common sense." The old rule laid down by Hippocrates "that there must be an exact balance between food and exercise, and that disease results from excess either way," is based upon sound principles.

FREQUENCY OF MEALS.

As regards the frequency of meals, it may be stated generally that three substantial meals in the day are sufficient for adults, and that the interval between one meal and another should not exceed five or six hours. During rest and sleep there is little or no demand for food, because the functions of the body are less active, and there is less waste going on.

The usual custom—breakfast at 8 a.m., dinner at 1 p.m., and supper at 6 p.m.—is that which seems best adapted to the needs of the soldier.

ELEMENTS OF COOKERY.

Cooking consists in the application of heat in such a manner as to convert our food from its raw state to a condition more favourable for digestion and nutrition, at the same time rendering it more acceptable to the sight and taste.

There is nothing of greater importance, as affecting the health and welfare of the soldier, than a good knowledge of the art of cookery. Badly-cooked food gives rise to indigestion, and excites a craving for strong drink; besides, much valuable nutriment is wasted through unskilful cooking. Food that is well cooked and savoury will be appetising and digestible; whereas the same food badly cooked and insipid will only excite disgust. Moreover, the skilful cook not only makes food tender and palatable, but provides that variety in meals which is so essential to the perfect nutrition of the body.

Dr. Lauder Brunton, in his work "On Disorders of Digestion," says:—"Some may think that, in speaking of cookery as a moral agent, I am greatly exaggerating its power; and they may regard it as idle folly if I go still further, and say that cookery is not only a powerful moral agent in regard to individuals, but may be of great service in regenerating a nation. Yet, in saying this, I believe I am speaking quite within bounds, and I

believe that schools of cookery for the wives of working men in this country will do more to abolish drinking habits than any number of teetotal associations."

The principal operations of cookery are boiling, roasting, baking, frying, broiling, and stewing.

Boiling.—Fresh meat should be plunged at once into boiling water, so as to form a coating of hardened albumen on the surface, which prevents the escape of the nutritive juices from the interior. After continuing the boiling for five or six minutes, the water should then be kept at a temperature not exceeding 160° Fahr., till the meat is sufficiently cooked. If the heat be excessive, the meat is rendered hard, shrunken, and tasteless.

Boiling is the most economical of the cooking processes, and boiled meats, though less savoury, are more easily digested. It is unsuited, however, to the flesh of young animals, which abounds in substances readily dissolved in water.

Salt beef, salt pork, and salt fish should be put on in cold water, and slowly boiled; the addition of a little vinegar to the water is recommended, with the view to soften the hardened texture of the meat. Fresh fish should be put on in boiling water, to which salt has been added; by this means it becomes firmer, and retains more of its flavour.

Roasting is conducted on the same principles as

boiling. To retain the soluble juices, the meat must first be subjected to a strong heat before a good open fire, and afterwards allowed to roast slowly. It is the most suitable mode of cooking ducks, geese, venison game, pork, and the flesh of young animals. The fat and other matters which exude from the meat into the dripping-pan should be used for frequent *basting.* The usual time allowed for roasting is a quarter of an hour for every pound of beef, mutton, goose, and turkey, and from seventeen to twenty minutes for every pound of pork or veal.

Baking is virtually the same as roasting, only it is done in a closed oven, and the heat is more equally maintained. The oven must be kept scrupulously clean; otherwise the meat is liable to acquire the unpleasant flavour of burnt fat.

Frying is conducted through the medium of butter, lard, dripping, or oil, at a temperature of 380° or 400° Fahr. The frying-pan should be six inches deep, and charged with sufficient oil or fat to cover the article to be fried. The fish or meat should be immersed in the melted fat or oil at the above temperature, and left until its surface becomes a light golden brown. Good frying fat can be used repeatedly, but requires to be clarified from time to time.

Broiling is done on a grid-iron over a clear brisk fire.

The grid-iron must be heated, and the bars rubbed with a little fat before the meat or fish is put on it. A chop or steak takes from ten to twelve minutes to cook, and should be turned every two or three minutes. Steak-tongs, or a fork stuck lightly in the fat, should be used for turning, so that no gravy may escape.

Stewing is the best way of obtaining a wholesome and savoury dish at a minimum of cost. The meat is generally cut up and mixed with a large quantity of vegetables; little or no water is required—the juice of the meat and other articles being sufficient. The meat and vegetables should be placed in a saucepan in alternate layers, and allowed to stew slowly at a low heat for two hours. As a rule, tinned meats are more palatable when made into stews.

Bones contain a certain amount of nutriment, and as they form about twenty per cent. of the meat, it is desirable that they should be utilised as far as possible. They require to be broken up into small fragments, put into cold water, and slowly boiled for four or five hours. The soup resulting consists principally of gelatin dissolved in water, which alone is a very imperfect nutrient; but with the addition of groats, pearl-barley, pea-flour, or oatmeal, it can be made highly nutritious. All available scraps and trimmings of meat should be put into the pot with the bones.

SECTION VI.

DRINKS AND TOBACCO.

WATER, which is the drink provided for us by Nature, is derived from rain, springs, wells, rivers, and the distillation of sea water.

Rain water is pure and wholesome, but special care must be taken in its collection. It is liable to receive impurities from the surfaces upon which it falls, and if collected in towns or near large manufactories, it becomes tainted with the various matters contained in the smoke.

Springs are fed from subterranean reservoirs, which are themselves dependent upon the rain which percolates through the ground overlying them. The water yielded by springs is charged with gaseous and mineral matters, derived from the strata through or over which it has passed—the majority, if not the whole, of which are harmless. The deeper the source whence the water is obtained, the less liable it is to pollution from organic impurities. Springs rising from granitic, metamorphic, or trap rock generally yield very pure and wholesome water.

Wells are artificial springs, and should be sunk as deep as possible, so as to pass through an impermeable

stratum, such as sand, gravel, chalk, or granite. Water thus obtained is generally hard, but of great organic purity. The ground in the vicinity of a well ought to be kept free from animal or vegetable refuse, and the mouth of the well carefully covered and protected from external sources of impurity. Shallow wells, receiving their supply from superficial drainage, should only be used when other sources are not available. Wells in the neighbourhood of cesspools, graveyards, sewers, or badly constructed surface drains, should not be used, as they invariably contain decomposing organic matter.

River water is always more or less contaminated, especially in highly cultivated and thickly populated districts. "Nor is this to be wondered at, considering that rivers are the natural drains of the country, into which every particle of rain falling within their water-sheds (except that evaporated from the surface) ultimately finds its way, with everything which it is capable of dissolving or suspending." On the other hand, the impurities are largely diluted, and river water undergoes considerable purification by natural processes. For example, the Thames water is as pure at Hampton Court as it is one hundred miles higher up, although it has received large quantities of sewage between those points.

When the supply is obtained from a running stream,

a convenient spot should be selected for taking water for drinking and cooking, another lower down for watering cattle, and a third still lower for personal ablution and washing clothes. Precautions should be taken to prevent the stream being fouled at any points above where the drinking water is procured.

Distillation is now largely used at sea and in towns on the coast where the rainfall is scanty, but the water thus obtained is insipid, owing to deficient aëration. If, however, it is filtered through charcoal or exposed to the air in finely divided currents, it assumes the refreshing taste of spring water.

The chemical examination of water requires skill and practical knowledge, and it is extremely difficult for a person without special training to determine whether a water is good or bad. At the same time, the physical characters of good drinking water are important, and may be a help. Dr. Parkes lays down :—"If a water be colourless, clear, free from suspended matter, of a brilliant (or adamantine) lustre, devoid of smell or taste, except such as is recognised to be the characteristic of good potable water, we shall in the majority of cases be justified in pronouncing it a good and wholesome water ; whilst, according as it deviates from these characters, we shall be proportionately justified in regarding it with suspicion."

Water of a suspicious nature ought to be distilled, boiled, or filtered ; the two former are the most effectual, but the last has the advantage of convenience. Boiling kills most low forms of life, and is therefore a good safeguard against the communication of disease through the medium of drinking water. Filtering through animal charcoal or spongy iron removes living organisms and suspended impurities. All filters require to be cleansed and to have the charcoal or other filtering material renewed periodically.

It is most essential to health that water should not only be good in quality, but sufficient in quantity. It is used for drinking, cooking, and ablution of persons, clothes, and dwellings ; for the flushing of closets and drains ; for the drinking and washing of animals, &c.

The quantity of water required per head daily is as follows :—

Domestic use, without baths or closets . .	12	gallons.
Water-closets	6	,,
Bathing	4	,,
Unavoidable waste	3	,,
	25	,,

There are two classes of beverages which are in use in nearly every country in the world. The first includes tea, coffee, and cocoa ; the second spirits, wine, and beer.

Tea is soothing to the nervous system: it increases the action of the heart, lungs, and skin, and enables the body to resist the depressing effects of exposure and fatigue. Dr. Parkes says "that it should form the drink *par excellence* of the soldier on service. It has been found equally serviceable in the Arctic regions and in the Tropics. In the expedition to the North Pole, under Sir George Nares, tea was preferred to spirits. Captain Burnaby, in his "Ride to Kkiva," speaking of tea, says:—"This beverage becomes an absolute necessity when riding across the Steppes in mid-winter, and is far superior in heat-giving properties to any wine or spirits. In fact, a traveller would succumb to cold on the latter when the former will save his life."

Coffee, like tea, has a restorative and invigorating effect, but is more stimulating to the nervous system. It is an important article of diet for soldiers, and is said to be protective against *Malaria*. Hot coffee with bread or biscuit is invaluable for men going on early morning or night duties. Dr. Hooker states that in the Antarctic Expedition the men all preferred coffee to spirits.

It should, however, be borne in mind that the intemperate use of either tea or coffee is apt to produce sleeplessness, tremor of the muscles, and indigestion.

Cocoa differs from tea and coffee in being much more

nutritious, and is therefore useful for men undergoing great physical exertion.

Spirits, wine, and beer owe their chief effects upon the system generally, and upon the different organs of the body, to a substance contained in them called *alcohol*, which is the stimulant in all intoxicating drinks. In small quantities, and in a diluted form, alcohol taken with a meal stimulates the stomach, increasing the flow of gastric juice and aiding digestion. But where the digestion is sound and healthy, this stimulating action tends to produce injurious rather than beneficial results.

That alcohol is not a necessity in health is clearly expressed by Dr. Lauder Brunton when he says :—" So long as a man is young and healthy, he does not require alcohol, and is better without it. I think it better in every way for people to abstain entirely from the use of alcohol until they reach the age of manhood."

The experience of former campaigns goes to prove that men are more healthy, more vigorous, and better able to bear fatigues, both in hot and cold climates, without either spirits, wine, or beer. The following instances, taken from Parkes' " Practical Hygiene," may be quoted.

" In the American War of Independence in 1783, Lord Cornwallis made a march over 2,000 miles in Virginia, under the most trying circumstances of

exposure to cold and wet; yet the men were remarkably healthy; and among the causes of this health, Chisholm states that the necessary abstinence from strong liquors was one."

"In 1800 an English army, proceeding from India to Egypt to join Sir Ralph Abercromby, marched across the desert from Kossier, on the Red Sea, and descended the Nile for 400 miles. Sir James McGrigor says that the fatigue of this march has perhaps never been exceeded by any army, and goes on to remark: 'We receive still further confirmation of the very great influence which intemperance has as a cause of disease. We had demonstration how very little spirits are required in a hot climate to enable a soldier to bear fatigue, and how necessary a regular diet is. At Ghenné, and on the voyage down the Nile (on account of the difficulties of at first conveying it across the desert), the men had no spirits delivered out to them, and I am convinced that from this not only did they not suffer, but that it even contributed to the uncommon degree of health which they at this time enjoyed. From two boats the soldiers one day strayed into a village, where the Arabs gave them as much of the spirit which they distil from the juice of the date-tree as induced a kind of furious delirium. It was remarked that for three months after a considerable number of these men were in the hospitals.'"

The late Inspector-General Sir John Hall says:—
"My opinion is that neither spirit, wine, nor malt liquor is necessary for health. The healthiest army I ever served with had not a single drop of any of them; and although it was exposed to all the hardships of Kaffir warfare at the Cape of Good Hope, in wet and inclement weather, without tents or shelter of any kind, the sick list seldom exceeded one per cent.; and this continued not only through the whole of the active operations in the field during the campaign, but after the men were collected in standing camps at its termination. And this favourable state of things continued until the termination of the war. But immediately the men were again quartered in towns and fixed posts, where they had free access to spirits—an inferior species of brandy sold there, technically called 'Cape Smoke'—numerous complaints made their appearance among them."

The experience of lumbermen in the back-woods of Canada has taught them the danger of indulgence in alcohol when the cold is intense, and therefore during the winter they are strict abstainers.

In advanced life, or in certain feeble conditions of digestion, a moderate quantity of whiskey and water, brandy and water, wine, or beer, may be useful and advisable at meals; but it should never be taken on an empty stomach, nor early in the day. The greatest

quantity of absolute alcohol which an average man can take daily without injury to his health has been estimated at one ounce and a half. This is equivalent to about one wine-glass of rum, or to about one wine-glass and a half of brandy or whiskey, or to about four wine-glasses of sherry, port, Maderia, or Marsala, or to about one pint of Burgundy, claret, hock, or champagne, or to about two pints of beer.

The moral, social, and physical evils of intemperance are universally recognised. "Nor does anyone entertain a moment's doubt that the effect of intemperance in any alcoholic beverage is to cause premature old age, to produce or predispose to numerous diseases, and to lessen the chance of living very greatly." (Parkes.) The following figures, taken from Neison's vital statistics, may prove of interest.

In intemperate persons the mortality at twenty-one to thirty years of age is five times that of the temperate; from thirty to forty it is four times as great.

A temperate person's chance of living is	An intemperate person's chance of living is
At 20 = 44·2 years	At 20 = 15·6 years
,, 30 = 36·6 ,,	,, 30 = 13·8 ,,
,, 40 = 28·8 ,,	,, 40 = 11·6 ,,
,, 50 = 21·25 ,,	,, 50 = 10·8 ,,
,, 60 = 14·285,,	,, 60 = 8·9 ,,

Tobacco is a stimulant and restorative which, if used in moderation, soothes nervous irritability, allays hunger,

and helps men to endure privations. Its effects are due to an active principle called *nicotine*, which is a powerful poison, and produces symptoms the opposite to those caused by *strychnine*, but equally fatal. When smoking is carried to excess, it produces tremors of the muscles, weakens the heart's action, and impairs the sight.

Moderation depends not only on the strength of the tobacco, but on the constitution of the smoker; and, as with everything else, one man may consume without injury what would be almost fatal to another. Smoking is a most pernicious habit in boys; it checks their physical as well as their mental development. No youth should touch tobacco before the age of twenty-three.

SECTION VII.

EXERCISE AND SLEEP.

IN accordance with an admirable law which prevails in Nature, muscles increase (within certain bounds) in size, power, and fitness, in proportion to the amount of exertion which they are called upon to make. If the exertion be not carried to excess, all other parts of the body share in the beneficial effects; the lungs expand more fully, and the amount of air inspired and of carbonic acid expired is enormously increased; the heart acquires new vigour, sending the blood with greater force into all parts of the system; the digestive functions are carried on with increased activity, a higher degree of health ensues; and the intellect (if at the same time cultivated) becomes sound and active.

Whilst over-exertion should be carefully avoided, disuse of the voluntary muscles is followed by wasting and feebleness of the body generally. A judicious amount of exercise is therefore essential to a vigorous and healthy existence. The following valuable rules for the regulation of physical exercise are laid down by Dr. Cathcart:—

(1) It should be conducted in an abundance of fresh air, and in costumes allowing free play to the lungs, and of a material which will absorb the moisture, and which, therefore, should be afterwards changed—flannel.

(2) There should be a pleasant variety in the exercise, and an active mental stimulus, to give interest at the same time.

(3) The exercises should, as far as possible, involve all parts of the body, and both sides equally.

(4) When severe in character, the exercises should be begun gradually and pursued systematically, leaving off at first as soon as fatigue is felt ; and when any real delicacy exists, the exercise should be regulated under medical advice.

(5) For young people, the times of physical and mental work should alternate, and for the former the best part of the day should be selected.

(6) Active exertion should be neither immediately before nor immediately after a full meal.

History teaches us that gymnastics were practised by the ancient Greeks, not only with the view to military efficiency, but as the best means of obtaining a robust habit of body, and through it a vigorous intellect. In such estimation were they held for this purpose, that both Plato and Aristotle thought that no republic could

be considered perfect in which gymnasia did not form part of the national institutions.

Nor did they estimate their value too highly, for it is now generally recognised that "the first requisite to success in life is to be a good animal, and to be a nation of good animals is the first condition of national prosperity." On the Continent, especially in Germany and Sweden, considerable attention is being paid to the best methods of promoting the physical development of the people.

Fortunately for England, sports and pastimes have always been a feature in the character of the nation, and this feature, judiciously trained and cultivated, is an important element of national greatness.

Field sports—hunting, shooting, fishing, etc.—not only supply the prime necessities of exercise and recreation, but tend to the formation of qualities which are in the highest degree useful in life—self-reliance, coolness, presence of mind, endurance, and fertility in resources.

Athletics may be regarded as including those manly games and pastimes which have been encouraged by all high-minded nations as calculated to develop and invigorate the bodily powers of their people.

Walking develops the muscles of the trunk and legs, increases the breathing power of the lungs, and improves the appetite and digestion. It is the most available

means of obtaining healthy exercise, and is a useful adjunct to other forms of exercise, especially rowing.

Running, jumping, and throwing heavy weights are severe forms of exercise, and ought not to be undertaken without previous training and practice.

Cricket is the most popular of English games, and has come to be regarded as a pastime of national importance to the health and physique of the people. The activity, quickness of hand and eye, self-reliance, decision, and sound emulation which the game of cricket calls forth are productive of much good.

Rowing is a healthy and pleasant means of obtaining exercise. The muscles employed are chiefly those of shoulders, arms, and back, and to a less extent those of the lower limbs. It is largely indulged in by the students of Oxford and Cambridge, and has been found to be attended by the best results.

Swimming is one of the most invigorating forms of recreation; it exercises almost all the muscles of the body, and cleanses the skin. It is the duty of every young person to learn to swim.

Polo, football, rackets, lawn-tennis, golf, and hockey are all admirable and popular games, and well adapted as a means of training body and mind for the battle of life.

Riding is a pleasant and exhilarating exercise,

suitable to all periods of life, from childhood to old age. The beneficial effects of horse exercise on a "sluggish liver" has given rise to the saying that "the outside of a horse is the best thing for the inside of a man."

Although the above forms of exercise may be sufficient for those who can take advantage of them, yet there is a vast and increasing section of the community to whom sports and pastimes are almost unknown. For this class, a course of training, such as men receive in the army, would be of inestimable value.

In addition to his military drills, &c., the recruit goes through a three months' course of gymnastic training, which often results in a pale and feeble youth being transformed into a robust and powerful man. The good effects of gymnastics are well exemplified in the case of twelve non-commissioned officers who were trained as gymnastic instructors for the army by Mr. McLaren, of the Oxford Gymnasium. The men ranged from 19 to 29 years of age, and in height from 5 feet 5 in. to 6 feet. In Mr. McLaren's own words :—" The muscular additions to the arms and shoulders and the expansion of the chest were so great as to have absolutely a ludicrous and embarrassing result, for before the fourth month several of the men could not get into their uniform jackets and tunics without assistance, and when they got them on,

they could not get them to meet by a hand's breadth. In a month more they could not get into them at all, and new clothing had to be procured, pending the arrival of which the men had to go to and from the gymnasium in their great-coats. One of these men had gained five inches in actual girth of chest." Mr. McLaren goes on to say:—"There was the change in bodily activity, dexterity, presence of mind, and endurance of fatigue: a change a hundred-fold more impressive than anything the tape measure or the weighing-machine can ever reveal."

It is difficult to determine the actual amount of exercise which a healthy adult should take; but the following facts are sufficiently established for practical purposes. A moderate day's work is generally taken at 300 foot tons, a hard day's work at 450, and a very hard day's work at 600. A certain time must be allowed for this work, as velocity increases its exhausting effects; or, in other words, "It is the pace that kills." Fifty foot tons an hour is considered a fair amount, and this rate is equal to a walk of three miles on a level road.

Professor Haughton has calculated that walking on a level surface is equivalent to raising 1-20th part of the weight of the body through the distance walked. "Using this formula," says Professor Parkes, "and

assuming a man to weigh 150 lbs. with his clothes, we get the following table:—

KIND OF EXERCISE.	WORK DONE IN TONS LIFTED ONE FOOT.
Walking 1 mile	17·67
,, 2 ,,	35·34
,, 10 ,,	176·7
,, 20 ,,	353·4
,, 1 ,, and carrying 60 lbs.	24·75
,, 2 ,, ,, ,,	49·5
,, 10 ,, ,, ,,	247·5
,, 20 ,, ,, ,,	495

"Looking at all these results," he continues, "and considering that the most healthy life is that of a man engaged in manual labour in the free air, and that the daily work will probably average from 250 to 350 tons lifted 1 foot, we can perhaps say, as an approximation, that every healthy man ought, if possible, to take a daily amount of exercise in some way which shall not be less than 150 tons lifted 1 foot. This amount is equivalent to a walk of about nine miles; but then, as there is much exertion taken in ordinary business of life, this amount may be in many cases reduced."

Man is said to be a low-pressure engine, working all his organs considerably under their full power. In the case of exercise, the amount required for the purposes of health is far short of that which can be accomplished by men in good training and condition.

The following instances of long marches during war may be interesting, as well as instructive :—

"The 43rd, 52nd, and 95th Regiments of Foot, forming the Light Division under Crawfurd, made a forced march in July, 1809, in Spain, in order to reinforce Sir Arthur Wellesley at the battle of Talavera. About fifty weakly men were left behind, and the brigade then marched sixty-two miles in twenty-six hours, carrying arms, ammunition, and pack—in all, a weight between 50 lbs. and 60 lbs. There were only seventeen stragglers.

"One of these regiments—the 52nd—made in India, in 1857, a march nearly as extraordinary. In the height of the mutiny, intelligence reached them of the locality of the rebels from Sealkote. The 52nd and some artillery started at night on the 10th of July, 1857, from Umritzur, and reached Goodasepore, forty-two miles off, in twenty hours, some part of the march being in the sun. On the following morning they marched ten miles, and engaged the mutineers. They were for the first time clad in the comfortable grey or dust-coloured native Kharki cloth.

"A company of a regiment of Chasseurs of MacMahon's army, after being on grand guard, without shelter or fire, during the rainy nights of the 5th-6th August, 1870, started at three in the morning to re-join its

regiment in retreat on Neiderbronn, after the battle of Weissenburg. It arrived at this village at 3.30 in the afternoon, and started again for Phalsbourg at 6 o'clock. The road was across the hills and along forest tracks, which were very difficult for troops. It arrived at Phalsbourg at 8.30 o'clock in the evening of the next day. The men had, therefore, marched part of the night of the 5th-6th August, the day of the 6th, the night of the 6th-7th, and the day of the 7th till 8.30 p.m. The halts were eight minutes every hour from 3.30 to 6, one hour in the night of the 6th-7th, and 2½ hours on the 7th. Altogether, including the halts, the march lasted 41½ hours, and the men must have been actually on their feet about thirty hours, in addition to the guard duty on the night before the march.

"An officer of a Saxon Fusilier Regiment gave the following statement of a forced march in one of the actions at Metz in 1870. The regiment was alarmed at midnight, and marched at 1 a.m., and continued marching, with halts, until 7 p.m.; they bivouacked for the night, marched at 7 the next morning, came into action at 1.30, and in the evening found themselves 15 kilomètres beyond the field of battle. The total distance was 53½ miles in forty-two hours, with probably 15 hours' halt.

"Roth mentions that the 18th Division of the Saxon

army in the various manœuvres about Orleans marched, on the 16th and 17th of December, 1870, 54 English miles.

"Von der Tann's Bavarian army, in retreat on Orleans, marched 42 miles in twenty-six hours.

"After Sedan, the Prussian and Saxon troops pushed on to Paris by forced marches, and accomplished, on an average, 35 kilomètres, or $21\frac{2}{3}$ miles, daily, and they marched on some days 42 to 45 kilomètres (26 to 28 miles). They started at five or six, and were on their ground from four to eight o'clock, the average pace being 5 kilomètres (3·1 miles) per hour.

"In the Indian Mutiny several regiments marched 30 miles a day for several days."

It should be observed that the larger the body of men, the slower the march. A single regiment can do 20 miles in eight hours, but a large army will take twelve or fourteen, including halts. (Parkes.)

SLEEP.

Sleep is that period of repose, or rest, which is requisite for the renewal of the muscular and nervous energy which active exertion tends to exhaust. Different individuals and ages require different amounts of sleep. The popular idea that a child sleeps half its time, an adult one-third, whilst an old person may do little

except eat and sleep, is near the truth. Seven or eight hours is usually ample for healthy adults, with nine hours on Sundays. Some men can do with much less: for instance, Sir George Elliot, who commanded at the great siege of Gibraltar, never slept more than four hours in the twenty-four during the siege, which lasted nearly four years.

SECTION VIII.

CLOTHING.

The chief object of clothing is to protect the body against hurtful variations of cold and heat, with as little restraint upon the movements of the limbs and the action of the internal organs as possible.

For protection against cold, wool is much superior, weight for weight, to either cotton or linen. Its capacity for absorbing moisture renders it most suitable for under-clothing, especially after exertion, when it prevents too rapid cooling of the body. Merino, which is a mixture with twenty to fifty per cent. of wool, is light and porous, and well adapted for under-clothing in hot climates. It is less liable than flannel to deteriorate—shrink and become hard—by frequent washing.*

For protection against cold winds and rain, leather and indiarubber fabrics, according to Dr. Parkes, take the first rank, wool the second, and cotton and linen

* In washing woollen articles, they should never be *rubbed* or *wrung*. They should be placed in a hot solution of soap, moved about, and then plunged into cold water. When the soap is got rid of, they should be hung up to dry without wringing. (Parkes.)

the last. Waterproof clothing is, however, unsuited for constant wear, as it retains and condenses the perspiration.

As a protection against excessive solar heat, the texture of clothes has little influence; this depends chiefly, if not entirely, on colour. White has the greatest protecting power; then grey, yellow, pink, red, blue, black. For hot climates, therefore, white or grey clothing should be chosen.

As regards the garments themselves. "Everything," says Dr. Parkes, "should be as simple and effective as possible; utility, comfort, durability, and facility of repair are the principles which should regulate all else."

The popular advice to "keep the feet warm and the head cool" is a sound maxim, and should be carefully carried out. The head-dress should be light, well ventilated, and impervious to rain; it should fit easily, and not press on the head. A heavy head-dress is apt to produce a sense of oppression, and to diminish the supply of blood going to the scalp. The actual weight of certain head-dresses may be interesting.

The tall black hat weighs 7 ozs., the Infantry helmet 14½ ozs., the Hussar busby 29¾ ozs., the Lancer cap 34½ ozs., the bearskin 37 ozs., the helmet of the heavy Dragoons 39 ozs., and the helmet of the Cavalry of the Guard 55 ozs.

The boots should be of such a size and shape as to allow of the free expansion of the foot during the act of walking; the inner line of the boot should be straight, so as not to push the great toe outwards. The soles should be flexible and impervious to wet; the heels low and broad, for the purpose of giving firm support to the weight of the body. A perfectly rigid sole prevents the foot from exerting its natural spring and action, and tends to cause wasting of the muscles of the leg.* Boots or shoes that are made too narrow at the toes are liable to produce corns, bunions, and in-growing toe-nails. Professor Koch, in a lecture delivered at Berlin in 1888, stated that at the beginning of the last war, 30,000 men were made useless for service owing to unsuitable foot-gear.

* A pair of light shoes might, with advantage, be substituted for the extra pair of ankle boots which the soldier carries in his pack. (R. C. E.).

SECTION IX.

CLIMATE.

By climate is understood the combined effect of heat, moisture, atmosphere, wind, soil, and electrical conditions in their relation to animal and vegetable life.

The human body seems to have a marvellous power of adapting itself to varying climatic conditions; and it may be accepted as a general principle that, so long as reasonable care is observed, a healthy man can live and flourish on almost any part of the earth's surface.

Much of the sickness that was formerly attributed to climate is known now to be really due to local insanitary conditions.

"Take away these sanitary defects," says Dr. Parkes, "and avoid malarious soils, or drain them, and let the mode of living be a proper one, and the European soldier does not die faster in the tropics than at home."

The soil or site on which a dwelling is built has considerable influence on the health of the inhabitants. Dry and permeable soils, such as gravel, sand, and chalk, or those which have such a slope as to allow

of natural drainage, are healthy; on the other hand, flat, moist, and alluvial soils are unhealthy. Soils containing much organic matter are to be avoided, such as those made in towns from rubbish of all sorts, as well as marshy districts.

The air in soils is almost always impure, hence the necessity for covering the site on which a dwelling is to be placed with a layer of concrete or other impermeable material, so as to prevent the *ground-air* from rising within the house.

At varying depths below the surface there exists a subterranean sheet of water, known as *ground* or *sub-soil water*, which is in constant movement, in most cases flowing towards the nearest water-courses or the sea. Much importance is attached to it; and Professor Von Pettenkofer lays down that a permanently high ground water—that is, within five feet of the surface—is bad, while a permanently low ground water—that is, more than fifteen feet from the surface—is good.

Vegetation, as a rule, has a beneficial influence on soils. In cold climates, trees shelter from the cold winds, but they obstruct the passage of the sun's rays to the soil, thus rendering it liable to be cold and damp.

In hot climates, trees shade the ground and make it cooler, whilst the evaporation from the leaves lowers

the temperature of the air and tends to dry the soil. It has been found that the evaporation from an oak-tree during the summer was $8\frac{1}{3}$ times the rain-fall; and observations in Algeria have shown that the blue gum-tree absorbs and evaporates 11 times the rain-fall. Herbage is always healthy; in the tropics it shades the ground from the direct rays of the sun, and tends to cool and equalise the temperature.

In dense forests there is generally an accumulation of decaying vegetable matter, which, under the influence of heat, moisture, and stagnant air, is productive of malarial fevers.

Brushwood is objectionable in the neighbourhood of dwellings, and should be removed.

In selecting a site for habitations, a dry, porous soil should be chosen: in an elevated position, if available, and on a gentle slope favourable to free drainage. Hollows or enclosed valleys should be avoided, as well as positions in close proximity to the foot of hills.

Dr. Parkes gives the following five conditions as requisite to ensure healthy habitations:—

(1) A site dry, and not malarious, and an aspect which gives light and cheerfulness.

(2) A system of ventilation which carries off all respiratory impurities.

(3) A system of immediate and perfect sewage

removal, which shall render it impossible that the air shall be contaminated from excreta.

(4) A pure supply and proper removal of water; by means of which perfect cleanliness of all parts of the house can be ensured.

(5) A condition of house construction which shall ensure perfect dryness of the foundation, walls, and roof.

SECTION X.

PREVENTION OF DISEASE.

THE best means of preventing disease is to be found in a careful and loyal obedience to established sanitary principles, as laid down with reference to cleanliness, pure air, pure water, proper food and drink, good drainage, and unpolluted soils. Such precautions are preventive of malarial fevers, cholera, enteric fever, yellow fever, typhus, dysentery, diphtheria, erysipelas, lung diseases, &c.

Small-pox is guarded against by vaccination and re-vaccination. The primary operation should be performed within four or six weeks after birth, and repeated after the fourteenth year. The evidence as to the efficacy of vaccination is very conclusive. "In the Franco-German war, which took place in the great epidemic years 1870-72, small-pox was introduced into the French army by the Breton recruits, and carried off 23,000 men; while the Germans, who followed on their track, and had, moreover, charge of most of their sick, but who, if not vaccinated in childhood, were so on enlistment, lost only 226." Dr. Collie, in "Quain's Dictionary of Medicine," says:—"It may be stated generally that the unvaccinated

will die at the rate of 50 per cent., the badly vaccinated at the rate of 26 per cent., and the well vaccinated at the rate of about 2·3 per cent."

In the case of scarlet fever and measles, a good sanitary condition lessens their severity, and isolation arrests their spread.

During the Middle Ages frightful epidemics of plague, sweating sickness, and other diseases, visited this country at frequent intervals, and caused immense mortality. It has been stated that in 1348 half the population of England perished of plague alone. The epidemic swept over the whole of Europe, killing about twenty-six millions of people, "and the ravages were fiercest in the greater towns, where filth and undrained streets afforded a constant haunt for leprosy and fever."

In London, from 1660 to 1670—a period in which the plague was prevalent—the death rate was 80 per 1,000. But when the worst plague-spots—the small, overcrowded, and filthy houses in the metropolis—were destroyed by the Great Fire, the disease became less severe. This led to increased attention being paid to the demands of sanitary science, and since then the death rate of London has gradually diminished. At the beginning of the nineteenth century it had fallen to 29 per 1,000; in 1840-49 it was 25·3; in 1870-78 it was 23; and at the present time it is under 20. This

remarkable decrease in the mortality is, undoubtedly, due to the enormous sanitary improvements which have been carried out in the city during the present century.

"Whoever," says Dr. Parkes, "considers carefully the record of the mediæval epidemics, and seeks to interpret them by our present knowledge of the causes of disease, will surely become convinced that one great reason why those epidemics were so frequent and so fatal was the compression of the population in faulty habitations. Ill-contrived and closely-packed houses, with narrow streets, often made winding for the purposes of defence ; a very poor supply of water, and therefore a universal uncleanliness ; a want of all appliances for the removal of excreta; a population of rude, careless, and gross habits, living often on innutritious food, and frequently exposed to famine from their imperfect system of tillage—such were the conditions which almost throughout the whole of Europe enabled diseases to attain a range and to display a virulence of which we have now scarcely a conception. The more these matters are examined, the more shall we be convinced that we must look, not to grand cosmical conditions ; not to earthquakes, comets, or mysterious waves of an unseen and poisonous air ; not to recondite epidemic constitutions, but to simple, familiar, and household conditions, to explain the spread and fatality of the mediæval plagues."

In former campaigns it was reckoned that for one man who was killed in battle six died from diseases, such as typhus fever, cholera, dysentery, &c. During the first winter, 1854-55, in the Crimea, the average strength was 31,333, and the losses from disease 10,285; in the second winter, 1855-56, the average strength was 50,166, and the losses from disease only 551. This wonderful change in the rate of mortality was due to the labours of the Army Sanitary Commission, which was sent out to the Crimea in the spring of 1855. The beneficial results achieved by this Commission, as well as the practical lessons in sanitary science taught by Crimean experience, are well described in the "History of the United States Sanitary Commission," from which the following brief extracts are taken:—

"At that time the experience of the Crimean War was fresh in the memory of all. That experience was a complete chapter by itself on Sanitary Science. It taught the great truth that the 'cause of humanity was identified with the strength of armies.' We were left in no vague conjecture as to the causes which produced the fearful mortality among the allied troops before Sebastopol—a mortality which, as has been truly said, has never been equalled since the hosts of Sennacherib fell in a single night. Public opinion in England, indignant and horror-stricken at this frightful result, long

before the war closed, called loudly for investigation and remedy. The result has been a contribution of inestimable value to our knowledge of everything which concerns the vital questions of the health, comfort, and efficiency of armies.

"The experience of the Crimean War taught those who consulted it the nature of the terrible dangers which encompass all armies outside of the battle-field, the possibility of mitigating them, and the sanitary measures which, in strict accordance with the general laws of health, should be adopted to provide for the safety of an army.

"The importance, therefore, of rousing public opinion to the absolute necessity of forcing upon the Government the adoption of precautionary measures to ensure the lives and safety of our troops in camps, in barracks, and in hospitals, was the practical lesson which was taught by the Crimean experience of those who had studied it, with a view to rendering it applicable to our needs.

"The powers conferred on the British Sanitary Commission were wholly unexampled in the history of the administrative system of Great Britain. The results of its labours have been, on the whole, perhaps the grandest contribution ever made by Science to the practical art of preserving health among men required

to live together in large masses. Its existence was due, as we have said, to the horror which was inspired by the accounts of the perishing army before Sebastopol, and to the widespread conviction that this result was attributable to causes which might be removed by wise sanitary measures. Three gentlemen, each distinguished for his practical acquaintance with the laws of Hygiene and the principles of Sanitary Science—Dr. Sutherland, Dr. Hector Gavin, and Mr. Rawlinson *—were appointed in February, 1855, by the Minister of War, Lord Panmure, commissioners to proceed at once to the Crimea (subsequently, on the death of Dr. Gavin, Dr. Milroy was appointed), and there, on the spot, to reform the abuses to which the evil was due."

Again, Dr. J. N. Radcliffe, in "The Hygiene of the Turkish Army," writes :—"The cleanliness of a camp is a subject of peculiar importance, and the methods of attaining cleanliness merit more attention than they have yet received on the part of military officers.

"Cleanliness, so far as the neat aspect of a camp is concerned, is highly gratifying to the eye ; but this may be, and indeed often is, attained, and yet some of the worst sources of atmospheric pollution, from a misapprehension of their effects, are allowed to remain.

"The continued inhalation of an atmosphere tainted

* Now Sir Robert Rawlinson, C.B.

by decomposing organic matter, such as is usually rife in a camp, is one of the most powerful predisposing causes of those terrible epidemics which ravage armies. It insidiously deteriorates the health, and lays the foundation necessary for the development of fever, cholera, and other cognate diseases; and inasmuch as it is less palpable in its effects than bad diet, excessive fatigue, intemperance, and other potent predisposing causes of disease, which are apt to affect an army in the field; and as it is more generally—nay, is invariably—present in a greater or less degree, it requires more constant and watchful attention. Remove the predisposing causes of an epidemic disease, and the exciting cause becomes, as a rule, inoperative; diminish the former in degree, and the latter will be proportionately diminished in effect. For many years the experience of civil life has shown that the emanations from decomposing substances act most powerfully in predisposing the system to the development of fever, dysentery, diarrhœa, and cholera. The experience of the allied armies during the war in the Crimea has shown that in the camp the effluvia from putrescent matters were equally powerful agents in the development of diseases among the soldiers, and that the diseases thus developed were similar in character to those witnessed under the same circumstances in civil life.

"To diminish the sources of atmospheric vitiation in a camp, it is requisite that proper receptacles should be provided for all ejected matters whatsoever; that it should be imperative upon the soldier to use these receptacles; that measures should be had recourse to for the destruction of such rejected matters as cannot be readily and deeply buried; that a systematic watchfulness should be observed on the part of the officers; and that special regulations should be adopted for the guidance of the men. Nothing can be done effectually without a properly organised scheme of action, equally affecting the superior and inferior grades of officers and the men. The sanitary state of a camp is a matter of too great importance to admit of the measures necessary to secure the conditions most favourable to the preservation of health being left to the option of one man or another.

"Not unfrequently the site of an encampment was insufficiently prepared, the drainage in particular being defective; and when the soil happened to be naturally moist, the air within the tents was rendered damp, and this condition operated as a powerful localising cause of zymotic disease."*

Vast improvements have been made in army sanitation since the Crimean War; and the errors and

* "The Hygiene of Armies in the Field," by Sir Robert Rawlinson, C.B.

mal-arrangements of former times are now corrected—or, at least, the means of correcting them are known.

It remains for the soldier to realise how much he has within his own power, as regards his well-being and physical happiness.

Professor Huxley says:—"Knowledge of Nature is a guide to practical conduct. Anyone who tries to live upon the face of this earth without attention to the laws of Nature will live there for but a very short time, most of which will be passed in exceeding discomfort; a peculiarity of natural laws, as distinguished from those of human enactment, being that they take effect without summons or prosecutions."

An effort has been made in the preceding pages to inculcate a knowledge of the laws of life and health, whereby men may be enabled to live in comfort, and to maintain their bodies in a condition not only free from disease, but full of energy, strength, and endurance; and from these results they may learn to look upon sanitary regulations not "as mere commands based on no particular grounds," but as rules founded on the noblest of all sciences—the Science of Health.

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